HF Fax on a Shoestring

Most SWLs with a PC can see the world for something less than $20

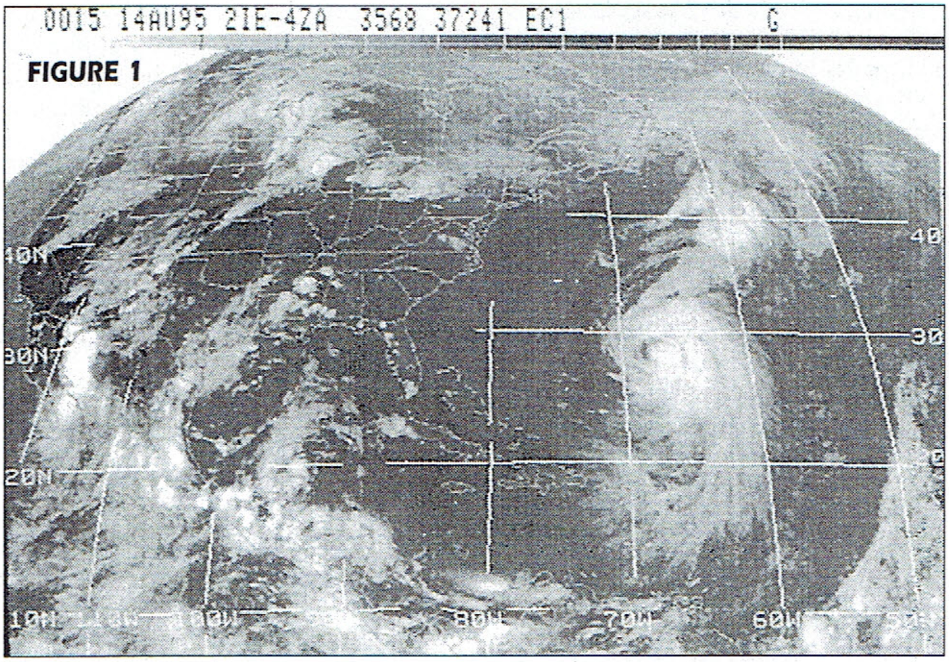
By Brian Webb

Anyone who's done much shortwave listening has heard them: odd, repetitive sounds similar to a dragging chain or squeaking wheel. These noises are the hallmark of facsimile (fax) transmissions. Every day numerous HF stations broadcast an interesting variety of weather charts, satellite pictures, and news photos.

HF fax reception has intrigued many shortwave enthusiasts, but they've been put off by the price. Most commercial HF fax demodulators cost at least $300, with some units priced at well over $1,000. Luckily, there's an inexpensive alternative.

For less than $20, most SWLs with an HF receiver and an IBM compatible PC can receive shortwave fax transmissions. It's done with a simple-to-build demodulator and some sophisticated free software. Don't let the low cost of this project fool you; although the cost is next to nothing, you get fax reception equal to or better than the expensive commercial units. Sometimes, the results can be impressive, as shown in Figure 1.

FIGURE 1



This HF fax image of Hurricane Felix was received using the demodulator and software described in this article.

Receiving System

The HF fax receiving system described in this article consists of an antenna, communications receiver, demodulator, an IBM-compatible 286 or later PC with VGA graphics, and JV-FAX software (Figure 2).

Any good shortwave antenna should suffice. However, it should be located away from TV sets, computers, and other electronic devices to minimize pick-up of the interference they generate. I've had good results using an end-fed, horizontal long wire 75 feet (22.7 meters) in length.

Fax image quality largely depends on the receiver. Best results will be had with a sensitive, stable, selective communications receiver such as a Kenwood R-5000. Good fax reception is possible with many mid-range models such as the Sangean ATS-818CS. I've even seen faxes received on an old Radio Shack DX-302. However, any receiver intended for fax reception must be capable of CW and SSB reception.

The demodulator is a simple analog-to-digital converter. It takes the analog audio signal from the receiver's headphone jack, converts it to a digital signal, and feeds it into the computer's communications port. The demodulator circuit (Figure 3) is based on a 751 op amp IC, uses few components, and is easy to build. The required components are listed in Table 1.

The final system component is an IBM-compatible 286 or later personal computer

TABLE 1
Demodulator Parts List

Code	Description	Radio Shack Part Number
C-1	Capacitor, 0.1 uF	272-1069
C-2	Capacitor, 1.0 uF tantalum	272-1434
C-3	Capacitor, 1.0 uF tantalum	272-1434
D-1	Diode, 1N4148	276-1122
D-2	Diode, 1N4148	276-1122
D-3	Diode, 1N4148	276-1122
D-4	Diode, 1N4148	276-1122
J-1	Connector, female DB-25	276-1548
P-1	Audio plug, 1/4- or 1/8-inch	
R-1	Resistor, 100-k Ohm, 1/4-watt	271-1347
R-2	Resistor, 100-k Ohm, 1/4-watt	271-1347
U-1	OpAmp, LM-741	276-007
W-1	Cable, shielded audio	278-512
	Circuit Board, perforated	276-159
	Socket, IC	276-1995

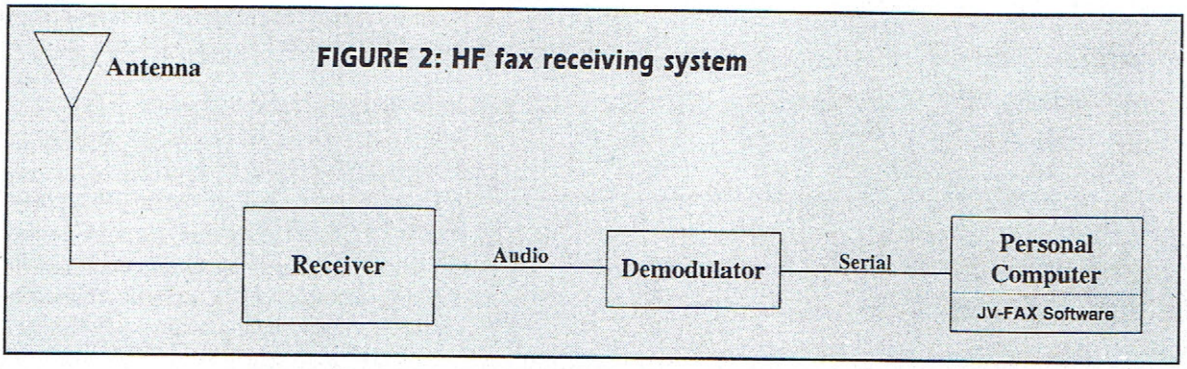


FIGURE 2: HF fax receiving system

with VGA or SVGA graphics. Residing within the PC is the sophisticated JV-FAX software. Two versions of the software—JV-FAX 7.0 and 7.1—are currently in use. The two are virtually identical, except that 7.0 saves faxes as GIF files, and 7.1 saves them as TIFs. The software is available free of charge from numerous sources (Table 2). This article will assume that you'll be installing and using JV-FAX 7.0.

Software Installation

Software installation is fairly simple, but since I had to discover how to install and operate the program by pure trial and error, this article will lead you through the procedure. It involves gathering com port address and IRQ information regarding your PC, creating places on the hard drive for the program and received faxes, loading the JV-FAX program, decompressing the files, and configuring the program's Mode and Configuration screens.

Areas on the C drive for the program and faxes are created as follows:

PC

- Go to the DOS prompt.
- Verify that the C drive has been selected.
- Type mkdir JVFAX <Return>
- Type mkdir HFFAX<Return>

To obtain com port address and IRQ information regarding your PC, do the following:

- Turn the printer ON.
- Go to the DOS prompt.
- Verify that the C drive has been selected
- Type msd <Return>
- The MS Diagnostics menu appears.

TABLE 2
JV-FAX Software Sources

ARRL BBS :	860-594-0306
Compuserve Ham Net Forum Library	

MS Diagnostics Menu

- Type c
- The Com Port Summary screen appears

Com Port Summary Screen

- Press Shift + Print Scrn
- Type ok <Return>
- The MS Diagnostics menu reappears

MS Diagnostics Menu

- Type q
- The IRQ Status screen appears

IRQ Status Screen

- Press Shift + Print Scrn
- Type ok <Return>
- The MS Diagnostics menu reappears

MS Diagnostics Menu

- Press F3
- The DOS prompt appears

To install the JV-FAX program, you will need to obtain the JV-FAX software from a BBS or other source and load it to the path C:\JVFAX as follows:

- Go to the DOS prompt.
- Verify that the C drive has been selected.
- Type cd\JVFAX <Return>
- Type PKUNZIP JVFAX.ZIP <Return>
- The screen should begin listing files that have been decompressed.
- If the computer asks you to overwrite a file, type Y <Return>.
- Installation should now be complete.
- Type cd\ <Return>

Configure the software by following the procedure outlined below:

PC Main Screen

- Go to the DOS C:\ prompt.
- Type cd\JVfax <Return>
- Type JVfax <Return>
- The JV-FAX Main screen appears.

JV-FAX Main Screen

- Type m
- The Mode screen appears.

JV-FAX Mode Screen

Change the entries to the following:

- Mode: 1 Wefax576
- IOC: 576
- LPM: 120
- Deviation: 500
- ATC: on
- Intensity levels: 64
- Display width usage (%): 100
- Receive pictures inverted: on
- Press Ctrl + <Return>.
- The JV-FAX Main screen reappears

JV-FAX Main Screen

- Type c
- The JV-FAX Configuration screen appears

JV-FAX Configuration Screen

Change the entries in the following fields to read as indicated:

- Demodulator: 6 bits HAMCOMM
- addr: Set as appropriate (refer to the address information on the msd printout)
- IRQ: Set as appropriate (refer to the IRQ information on the msd printout)
- LSB-SSTV-sync: yes
- Bdrate: 9600
- Dtarate: 9600
- Graphics: Set as appropriate
- T-C graph: Set as appropriate
- Max interrupt frequency: 7500
- Default picture directory: C:\HFFAX
- Press Ctrl + <Return>
- The JV-FAX Main screen reappears

Receiving faxes

To receive an HF fax, do the following:

Receiver

- Tune to an active HF fax frequency (8,080.0 kHz is a good bet, or select an active frequency from Table 3)
- Tune the receiver 1.750 kHz above the listed carrier frequency (for example, to tune in NMN on 8,080.0 kHz, tune to 8,081.75 kHz).
- Go to LSB mode
- Select Narrow selectivity (about 1 kHz)
- Set the audio level to the 10 o'clock position.

PC Main Screen

- At the DOS prompt, type cd\JVFAX<Return>
- Type JVFAX <Return>

JV-FAX Main Screen

- Verify that the fax option is highlighted
- Press <Return>

JV-FAX Receive Screen

- Verify that the M): field is set to Wefax576
- Verify that the A)PT: field is set to "waiting"

- * Type a
- * The A)PT: field should read "running"

An image should slowly begin building up on the screen. If the fax is too dark, tune the receiver down in 0.1 kHz steps; if the image is too light, tune upwards like increments. The fax will probably be split the left side on the right and the right on the left. This is normal and is easily fixed later. After a fax has been received, save it with the following key strokes:

- * Type a
- * Press F2
- * Enter a file name with a .GIF extension (i.e., fax1.GIF)
- * Press <Return>
- * Exit the fax receive screen by typing q

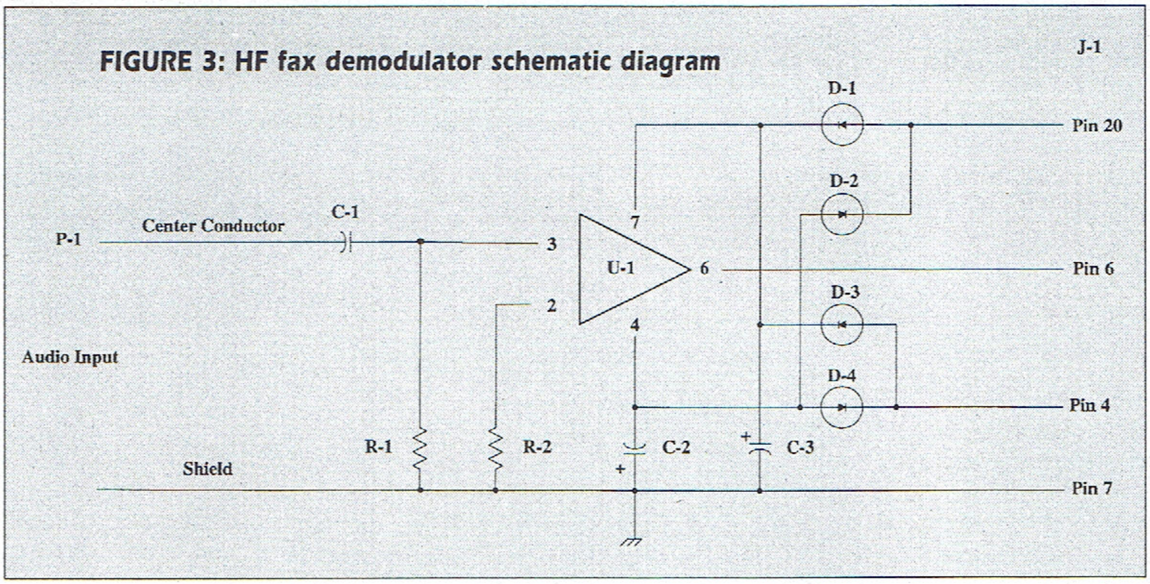


FIGURE 3: HF fax demodulator schematic diagram

Editing faxes

The software allows you to edit images in various ways including cropping, enhancing contrast, and changing their orientation. The most frequently used editing feature is roll correction. Virtually all faxes are received with a roll error which results in an image being split with the left portion showing up on the right side of the screen and vice versa. To repair a fax with this problem, go to the JV-FAX Main Screen and do the following:

- * Move the highlight bar to the "Show and Send Pictures" option
- * Press <Return>
- * The Fax Library Screen appears

Fax Library Screen

- * Move the highlight bar over the name of the file to be edited
- * Press <Return>
- * The Fax Viewing Screen with the saved image appears

Fax Viewing Screen

- * Press R
- * Move the vertical line to the center of the gutter
- * Press <Return>
- * Press F2
- * Type in a new file name for the image (i.e. FAX01.GIF)
- * Press <Return>
- * The Fax Library Screen reappears

Congratulations; you have now received, saved, and edited your first HF fax.

Fax Reception Hints

If your receiver has programmable memory channels, you can save yourself a lot of work by loading the frequencies of the stronger fax stations and group the frequencies used by each station together. These techniques make finding and tuning in transmissions easier and allows you to select the best frequency for a selected station.

The quality of the faxes received from a given station varies. Excellent reception one day may be followed by poor copy the next. Reception also varies with the time of day. It's worthwhile to check a station's signal quality on different frequencies at different times.

Another piece of advice is to ignore the tuning display on the software's fax receive window. The best tuning indication is fax image quality. Most faxes are best received 1.750 kHz above the station's carrier frequency. If the image is too dark, tune downward in 0.1 kHz steps; if it's too light, tune upwards in like increments.

Although most images are sent at 120 LPM with an IOC of 576, some pictures are sent using 60 LPM and an IOC of 288. This is especially true of stations in the former Soviet Union and East Asia. North Korean press photos are sent at 60 LPM with an IOC of 325. Faxes with these parameters can be received by going to the Mode screen and setting the IOC and LPM accordingly.

Conclusion

Fax reception opens up a new dimension to shortwave listening, allowing DXers to see radio as well as hear it. The combination of a low cost, simple fax demodulator, and sophisticated shareware puts this exciting capability within reach of virtually all SWLs. This nifty software combination also decodes Morse code and RTTY transmissions, so we encourage you to built it and you will see. For less than $20, how can you lose?!

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TABLE 3
HF Fax Stations

Transmit (kHz)	Receive (kHz)	Station	Time Heard/ Comments
3,233.0	3,234.75		00:15, 01:00-01:45, 02:15, 03:00, 03:30-07:00, 07:30-07:45
3,300.0	3,301.75		07:45-08:00
3,357.0	3,358.75	NAM?	00:00, 02:30-04:00, 04:30-06:00, 06:30-06:45, 07:15-08:00
3,359.0	3,360.75		04:45-05:00, 06:45
3,365.0			
4,271.0	4,272.75		00:15, 02:15, 03:15-03:30, 04:00-04:15, 05:00-05:30, 06:00-06:30, 07:00
4,298.0	4,299.75	NOJ	04:00-05:15 s/off
4,316.0	4,317.75	JJC, Tokyo	06:15-08:00, 14:15-16:15, 17:00, 17:30
4,346.0	4,347.75	NMC	02:45 s/on-04:30, 14:15-16:30 s/off, 20:15 s/on-22:15
4,516.7	4,518.45	RXI372	13:00-13:45
4,853.0	4,854.75		06:00-07:00, 12:45, 14:00-15:45
4,855.0	4,856.75	NPM?	00:00-00:15, 01:00-08:00
4,857.0	4,858.75		06:00-07:00, 12:30-12:45, 14:00-14:15, 14:45-15:45
5,100.5	5,102.25		07:15, 08:00, 12:30, 13:45, 14:15-15:30, 16:00-16:15
5,258.0	5,259.75		06:45-07:15, 08:00, 14:15-16:15, 16:45-17:00
5,262.0	5,263.75		06:45, 07:00-07:15, 08:00, 14:15-16:15, 16:45
5,908.0	5,909.75	USAF, Elk Horn, NE	00:00-00:30, 01:00-02:30, 03:00, 03:30-08:00, 12:30, 16:30-16:45
6,340.7	6,342.45		02:30-04:30, 08:00, 14:30-14:45, 22:15-22:30
6,453.0	6,454.35	NPG, USN, Stockton, CA	00:00-03:45, 04:15-04:30, 05:45-07:00, 12:30-12:45, 14:00-14:15, 14:45-16:30, 18:30-18:55 s/off, 21:15-23:30
6,496.0	6,497.75		00:00-00:15, 03:00-03:30, 04:00-04:15, 05:00-05:30, 06:00-06:30, 07:00, 07:30-08:00, 14:00-14:15, 15:15, 21:15-21:30, 23:00-23:15
6,852.0	6,853.75	WLO	00:15, 02:30, 05:15, 15:00, 21:45, 23:15, 23:45
6,906.0	6,907.75		00:45, 14:15-14:45
6,918.5	6,920.25	ECA7	00:15, 01:00, 04:00, 05:00, 05:45, 07:00, 07:30, 22:45
7,305.0	7,306.75		04:00-04:15, 04:45-08:00, 12:30-12:45, 15:30, 16:00-16:15, 16:45-18:00, 19:15
7,398.0	7,399.75		00:00-08:00, 17:00, 17:30
7,582.0	7,583.75		00:15, 01:15-01:45, 07:45, 14:15-16:15
7,670.0			05:00
7,870.0	7,871.75		00:00-07:30, 08:00
8,080.0	8,081.75	NAM	00:00-01:00, 01:30-02:00, 02:30-05:15, 05:45-06:45, 13:45-14:15, 15:00, 16:00-16:15, 18:15, 19:15, 19:45-20:00, 20:45-22:45, 23:15-23:30 Thermal IR satellite image @ 04:00
8,140.0	8,141.75	9VF44, Singapore	07:30, 14:15, 15:00-15:15, 16:00-16:15
8,458.0	8,459.75		04:30, 05:00, 18:15, 22:45
8,459.0	8,460.75	NOJ	04:15-05:15, 18:00-18:30, 19:15, 22:00-23:00
8,467.5	8,469.25	JJC	00:15, 03:30-04:00, 04:30-05:15, 05:45-08:00, 14:15-16:15, 16:45-17:30, 18:30, 19:15-19:30, 20:30-20:45, 22:15-23:15, 23:45
8,504.2	8,505.75	USCG?	00:15, 05:00, 07:45-08:00, 14:30, 15:00-15:15, 17:00, 19:15, 20:30, 21:00-21:15, 21:45, 23:15-23:45
8,682.0	8,683.75	NMC, USCG, Point Reyes, CA	02:45-04:15, v08:15-10:20, 14:15-16:15, v20:15-22:19, v23:00 -23:46 Satellite WX photo @ 09:08, 09:44, 14:49, 21:08 Sea surface temperature chart @ 23:04
9,090.0	9,091.75		00:15-01:00, 01:15-02:15, 03:00, 03:30, 04:30, 06:00, 12:30-12:45, 14:00-14:15, 14:45-16:30, 18:30-18:45, 19:15, 19:45, 21:15-23:30
9,110.3	9,111.85	USCG	04:00, 04:30, 08:00, 14:30-15:15, 15:45, 17:30-17:45, 19:15, 20:00, 21:00-21:45, 22:30 NWS wx maps of w. Atlantic & Caribbean
9,158.0	9,159.75		00:00-00:15, 05:15, 15:00, 19:15, 20:00, 21:15, 21:45, 22:15, 23:45
9,230.4	9,232.15		06:00-06:15, 13:45, 15:00, 16:00, 16:45
9,318.0	9,319.75		00:30, 07:30, 14:00, 15:00, 22:00, 22:30-22:45, 23:45
9,458.6	9,460.35		04:45, 06:15, 08:00
10,257.0			07:00
10,536.0	10,537.75	CFH	00:00-00:15, 02:00-02:15, 03:00-03:30, 05:15-05:30, 06:15-06:30, 07:30-07:45, 14:00-14:15, 15:00-15:30, 16:00-16:15, 17:00-17:15, 18:00-21:30, 22:00-22:15, 23:00-23:15
10,555.0	10,556.75		08:00, 14:00, 14:30, 15:30, 19:15, 21:30, 22:00, 22:30
10,865.0	10,866.75	NAM	00:00, 02:00, 05:00, 13:45-14:15, 14:45-17:00, 17:30, 18:00-23:15, 23:45
11,030.3	11,032.05		04:30, 06:00-06:15, 08:00, 12:30-12:45, 15:00-15:30, 16:00-16:30
11,090.0	11.091.65	KVM70, Honolulu,	00:00-03:15, 03:45, 05:30, 06:00-06:45, 13:45, 17:30-19:15, 23:30-23:45
11,122.1	11,123.85		00:00-00:15, 00:45, 02:15, 03:15-03:30, 04:00, 04:30, 13:45-24:00
11,476.1	11.477.85	KCNA, Pyongyang, North Korea	00:00-00:30, 01:15, 23:30-24:00
11,622.3	11,623.85	USAF?	00:00-00:15, 03:15, 12:30-12:45, 14:00-17:00, 17:30-18:00, 18:30, 19:15, 19:30, 20:00-21:00-22:30, 23:00-23:15
12,730.0	12,731.75	NMC	02:45-03:45, 04:15, 14:15-16:15, 20:15-22:15, 23:00-23:45
12,745.5	12,747.25	JJC	00:00-01:00, 02:15, 03:30-03:45, 04:30, 05:15, 06:15-06:30, 15:00-17:00, 17:30, 19:45, 20:15-21:15, 22:15-23:45
12,750.0	12,751.75	NIK, USCG, Boston	02:30-03:45, 04:30, 14:15-15:45, 17:30-18:00, 19:00-22:30 Good WX maps
12,753.2	12,754.80	Canada	03:30 s/off, 15:30-15:45, 21:15-22:35 s/off Good WX maps
13,510.0	13,511.75		00:00, 14:15, 15:00-15:30, 16:00-16:15, 17:00, 18:15-18:30, 19:00-19:30, 20:00-20:30, 21:00-21:30, 22:00
13,580.0	13,581.75	KCNA	00:00-00:30, 01:00-01:30, 23:30-23:45
13,597.0	13,598.75		00:00-00:30, 01:00-01:30, 03:30, 05:15-05:30, 06:15, 12:30-12:45, 16:00, 16:45-17:00, 17:30, 20:30, 21:30, 22:00-22:15, 22:45-23:45
15.780.0	15,782.75		13:45-23:15, 23:45
16,027.5	16,029.25		00:15, 03:30-03:45, 04:15-04:45, 21:15 -23:30
16,135.0	16,136.75	KVM70	00:00-01:00, 01:45-03:15, 06:00, 17:30-19:15, 22:15, 23:30-23:45
16,340.0	16,341.75	ZKLF	01:00, 03:00-03:15, 04:00, 04:45, 06:00-06:15, 08:00, 16:45, 17:45, 20:00-22:15, 23:00-23:15, 23:45
17,069.6	17,071.35	JMG	00:00-00:45, 04:30, 05:15, 20:15, 21:00-21:15, 22:15-23:45
17,146.8	17,148.55	Chilean Navy	19:10 s/on-19:45, 22:15, 23:15-23:30 S.E. Pacific surface chart @ 19:15 WX satellite photo @ 19:30
17,148.0	17,149.95		14:30, 15:00, 17:00-17:15, 19:15, 21:00-21:15, 21:45, 23:15
17,151.0	17,152.85	NMC	02:45-03:30, 04:15, 14:45-15:15, 15:45-16:15, 20:15-22:15, 23:00-23:15, 23:45 Very good satellite photos
18,220.0	18,221.75		00:00-00:30, 01:15, 22:00-22:15, 22:45-23:15, 23:45
18,441.0	18,442.75		00:00-00:30, 22:00-23:15, 23:45
18,621.5	18,623.25		19:30
19,328.0	19,329.70		15:30, 16:15, 18:00-18:15, 19:00-19:15, 20:00-21:00, 21:30, 22:00-22:30
19,363.0	19,364.75		14:15-15:00-15:15, 15:30-17:00, 17:30-19:30. 20:00-23:15

NOTES
1. Receive frequencies are the actual frequencies to use to receive FAX transmissions in LSB mode.